

Coho and Chinook Salmon Smolt Releases into Cook Inlet, Prince William Sound, and Resurrection Bay, Alaska, 2005

by

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and

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October 2008

Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



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Weights and measures (metric)		General		Measures (fisheries)	
centimeter	cm	Alaska Administrative		fork length	FL
deciliter	dL	Code	AAC	mideye to fork	MEF
gram	g	all commonly accepted		mideye to tail fork	METF
hectare	ha	abbreviations	e.g., Mr., Mrs., AM, PM, etc.	standard length	SL
kilogram	kg			total length	TL
kilometer	km	all commonly accepted			
liter	L	professional titles	e.g., Dr., Ph.D., R.N., etc.	Mathematics, statistics	
meter	m			<i>all standard mathematical</i>	
milliliter	mL	at	@	<i>signs, symbols and</i>	
millimeter	mm	compass directions:		<i>abbreviations</i>	
		east	E	alternate hypothesis	H _A
		north	N	base of natural logarithm	e
		south	S	catch per unit effort	CPUE
		west	W	coefficient of variation	CV
		copyright	©	common test statistics	(F, t, χ^2 , etc.)
		corporate suffixes:		confidence interval	CI
		Company	Co.	correlation coefficient	
		Corporation	Corp.	(multiple)	R
		Incorporated	Inc.	correlation coefficient	
		Limited	Ltd.	(simple)	r
		District of Columbia	D.C.	covariance	cov
		et alii (and others)	et al.	degree (angular)	°
		et cetera (and so forth)	etc.	degrees of freedom	df
		exempli gratia		expected value	E
		(for example)	e.g.	greater than	>
		Federal Information		greater than or equal to	≥
		Code	FIC	harvest per unit effort	HPUE
		id est (that is)	i.e.	less than	<
		latitude or longitude	lat. or long.	less than or equal to	≤
		monetary symbols		logarithm (natural)	ln
		(U.S.)	\$, ¢	logarithm (base 10)	log
		months (tables and		logarithm (specify base)	log ₂ , etc.
		figures): first three		minute (angular)	'
		letters	Jan,...,Dec	not significant	NS
		registered trademark	®	null hypothesis	H ₀
		trademark	™	percent	%
		United States		probability	P
		(adjective)	U.S.	probability of a type I error	
		United States of		(rejection of the null	
		America (noun)	USA	hypothesis when true)	α
		U.S.C.	United States	probability of a type II error	
			Code	(acceptance of the null	
		U.S. state	use two-letter	hypothesis when false)	β
			abbreviations	second (angular)	"
			(e.g., AK, WA)	standard deviation	SD
				standard error	SE
				variance	
				population	Var
				sample	var
Weights and measures (English)					
cubic feet per second	ft ³ /s				
foot	ft				
gallon	gal				
inch	in				
mile	mi				
nautical mile	nmi				
ounce	oz				
pound	lb				
quart	qt				
yard	yd				
Time and temperature					
day	d				
degrees Celsius	°C				
degrees Fahrenheit	°F				
degrees kelvin	K				
hour	h				
minute	min				
second	s				
Physics and chemistry					
all atomic symbols					
alternating current	AC				
ampere	A				
calorie	cal				
direct current	DC				
hertz	Hz				
horsepower	hp				
hydrogen ion activity	pH				
(negative log of)					
parts per million	ppm				
parts per thousand	ppt, ‰				
volts	V				
watts	W				

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**COHO AND CHINOOK SALMON SMOLT RELEASES INTO COOK
INLET, PRINCE WILLIAM SOUND, AND RESURRECTION BAY,
ALASKA, 2005**

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ABSTRACT

Approximately 934,799 coho salmon *Oncorhynchus kisutch* and 1,866,594 Chinook salmon *O. tshawytscha* smolt were released in Cook Inlet, Prince William Sound, and Resurrection Bay in 2005. Only 13 of the 21 release groups were thermally marked to identify the area of release from returning adults. All 331,858 thermally marked Chinook salmon from three release groups were also marked with an adipose clip and a coded wire tag. Tag retention for individual release groups ranged from 99.4 to 99.9%. Percentage of individual release groups with acceptable adipose clips ranged from 99.1 to 99.9%. Fish size distribution at time of release was estimated for all three Chinook salmon release groups with coded wire tagged fish and one coho salmon release group without tags. All three of the coded wire tagged Chinook salmon release groups achieved a production goal of 80% of the smolt within a 5.1-15.0 g target size range. The production goal for coho salmon is to have 80% of the smolt within a 15.1-25.0 g target size range. The percentage of coho salmon smolt within the target size range for one release group was 68.5%.

The number of Chinook salmon in the three release groups with coded wire tags was obtained during tagging. Hatchery inventory methods were used to estimate the number of all 7 coho salmon release groups and 10 of 14 Chinook salmon release groups that did not receive adipose clips and coded wire tags. Water volume inventory methods were used to estimate the number of Chinook salmon in one release group.

Key words: hatchery, adipose-clip, coded wire tags, thermal marking, otolith, Chinook salmon, *Oncorhynchus tshawytscha*, coho salmon, *Oncorhynchus kisutch*, tag retention, size composition.

INTRODUCTION

Over half of Alaskans live in Southcentral Alaska, which receives the vast majority of the state's sport fishing effort. Chinook salmon *Oncorhynchus tshawytscha* and coho salmon *O. kisutch* smolt reared at Fort Richardson Hatchery (FRH) and Elmendorf Hatchery (EH) have been stocked in numerous locations throughout Southcentral Alaska to improve or create terminal sport fisheries and relieve pressure on wild stocks (Appendices A1 and A2). A critical element of the coho and Chinook salmon hatchery smolt stocking projects in Cook Inlet, Prince William Sound, and Resurrection Bay is the use of thermal marks (TM) to identify fish. Some salmon smolt are also marked with an adipose clip and a coded wire tag (CWT). TMs and CWTs are used to estimate the contribution of individual stockings to commercial fisheries, marine and freshwater recreational fisheries, and personal use fisheries. They can also be used to estimate spawning escapement in stocked streams, and estimate straying of stocked coho and Chinook salmon.

The accuracy of hatchery contribution estimates from CWT recoveries is highly dependent upon the accuracy of unmarked fish estimates in the release groups. Estimating the number of unmarked fish is not needed when using TMs because all fish are marked. However, determining the number of fish in each release group is still necessary. Three methods used at FRH and EH for determining the number of unmarked fish and/or total number of fish in release groups include a tagging inventory (TI) count, a hatchery inventory (HI) estimate, and a water volume displacement (WV) estimate.

Another important element of hatchery smolt stocking programs is fish size. Weight and length of hatchery smolt at release are indicators of quality (Peltz and Starkey 1993). If smolt are too small at release, then ocean survival will be poor; if smolt are too large at release, then ocean residence will be reduced, thus shifting age composition of returns to younger, smaller fish (Sweet and Peltz 1994). To maximize ocean survival of hatchery smolt and maintain the age composition of the existing population, Peltz and Starkey (1993) recommended that 80% of hatchery coho smolt released weigh between 15.1 and 25.0 g, and hatchery Chinook salmon

weigh between 5.1 and 15.0 g. Weight distribution was estimated for each smolt release group with CWTs and one release group of coho salmon without CWTs to determine smolt quality.

This project documented the release of Chinook and coho salmon smolt in Cook Inlet, Prince William Sound, and Resurrection Bay. Specific objectives for this project were:

1. To estimate the long-term (>30 days) tag retention rate and adipose clip quality of each smolt release group with CWTs;
2. Verify the TM applied to the otoliths of fish in each release group;
3. To estimate the weight distribution of each Chinook salmon smolt release group with CWTs and one coho salmon release group without CWTs.

Our tagging goal was to mark all Chinook salmon in three release groups with an adipose clip and a CWT. A second goal was to mark all fish in all release groups with an appropriate thermal mark. A task associated with this project was to compare smolt abundance using HI and WV estimates to the TI count for all Chinook salmon release groups marked with an adipose clip and CWT.

Included in this report are recommendations for future marking and collecting of smolt release data. All data for this report are held and archived by Research and Technical Services, Sport Fish Division, Alaska Department of Fish and Game (ADF&G).

METHODS

Coho salmon broodstock from Bear Lake, Ship Creek (Little Susitna River), and Eklutna Tailrace (Jim Creek) were raised at FRH. Chinook salmon broodstock from Deception Creek, Ship Creek, Crooked Creek, and Ninilchik River were raised at FRH. Chinook salmon broodstock from Ship Creek were also raised at EH. Fish from 21 release groups were stocked at 10 locations in Cook Inlet, 3 locations in Prince William Sound, and 2 locations in Resurrection Bay (Table 1).

SMOLT MARKING

Coded Wire Tagging

All Chinook salmon smolt in three release groups were adipose clipped and injected with a CWT. Unique tag codes were used for all release groups marked with CWTs.

To determine which head mold sizes would provide the best tag placement, a length frequency distribution was obtained by measuring the fork length (to the nearest millimeter) of at least 510 fish from each of the three broodstock within 7 days of tagging. Two or three head mold sizes that fit at least 80% of the length distribution were selected for tagging. All fish were graded and tagged accordingly with a full-length CWT (1.1 mm) using a Northwest Marine Technology¹ Mark IV tag injector.

Fish were anesthetized with MS-222 before tagging. The adipose fin was excised at the base using surgical scissors. Tags were then injected into the noses of the fish, and the fish were sent through a Quality Control Device (QCD). The QCD detected the magnetized tag and separated the fish with tags from those without tags. All fish without tags were injected again. Quality

¹ Use of a company's name does not constitute endorsement.

Table 1.-Total number of fish stocked at 15 locations in Cook Inlet, Prince William Sound, and Resurrection Bay in 2005.

Release area	Release location	Broodstock	Inventory method used	Estimated number of fish in raceway
<u>Chinook salmon</u>				
Cook Inlet	Deception Creek	Deception Creek	tagging inventory	163,016
Cook Inlet	Ship Creek	Ship Creek	hatchery inventory	344,191
Cook Inlet	Ship Creek	Ship Creek	water volume displacement ^a	13,838
Cook Inlet	Crooked Creek	Crooked Creek	tagging inventory	113,613
Cook Inlet	Eklutna Tailrace	Ship Creek	hatchery inventory	164,586
Cook Inlet	Halibut Cove	Ninilchik River	hatchery inventory	112,521
Cook Inlet	Homer Spit	Ninilchik River	hatchery inventory	220,822
Cook Inlet	Seldovia	Ninilchik River	hatchery inventory	114,984
Cook Inlet	Ninilchik River	Ninilchik River	tagging inventory	55,229
Resurrection Bay	Lowell Creek	Crooked Creek	hatchery inventory	100,088
Resurrection Bay	Seward Lagoon	Crooked Creek	hatchery inventory	114,847
Prince William Sound	Fleming Spit	Deception Creek	hatchery inventory	87,591
Prince William Sound	Valdez, Old Town Site	Deception Creek	hatchery inventory	143,209
Prince William Sound	Whittier	Deception Creek	hatchery inventory	118,059
<u>Coho salmon</u>				
Cook Inlet	Bird Creek	Ship Cr (Little Susitna River)	hatchery inventory	100,605
Cook Inlet	Campbell Creek	Ship Cr (Little Susitna River)	hatchery inventory	60,387
Cook Inlet	Eklutna Tailrace	Eklutna Tailrace (Jim Creek)	hatchery inventory	132,149
Cook Inlet	Homer Spit	Ship Cr (Little Susitna River)	hatchery inventory	125,707
Cook Inlet	Ship Creek	Ship Cr (Little Susitna River)	hatchery inventory	251,446
Resurrection Bay	Lowell Creek	Bear Lake	hatchery inventory	132,276
Resurrection Bay	Seward Lagoon	Bear Lake	hatchery inventory	132,229
Total				2,801,393

^a Surplus Chinook salmon from landlocked lake stocking program; released from Elmendorf Hatchery.

control checks for tag placement were conducted following initial daily startup, and following a change in head mold size or a change in tagging personnel. During each quality control check, a minimum of two tagged fish were dissected to determine tag placement (Moberly et al. 1977; Figure 1). Head mold or wire placement adjustments were made when necessary. The fish dissected to determine tag placement were not included in the tagged fish counts.

After tagging, all fish were held in net pens overnight to determine short-term mortality, short-term tag retention rates, and monitor adipose-clip quality. All overnight mortalities were counted and recorded. Short-term retention rates were estimated daily by passing a random sample of 200 fish through the QCD. Daily tag retention rate (D_i) of surviving smolt was estimated as a binomial proportion:

$$\hat{D}_i = \frac{n_i}{n_{ti}}, \quad (1)$$

where:

n_i = number of live smolt in the sample tagged on day i that retained the tag, and

n_{ti} = total number of live smolt in the sample tagged on day i ,

and a variance of:

$$Var(\hat{D}_i) = \frac{\hat{D}_i(1 - \hat{D}_i)}{n_{ti} - 1}. \quad (2)$$

The 200 fish checked for overnight tag retention were also examined for adipose-clip quality. Adipose clips were rated as acceptable or not acceptable. An acceptable adipose clip occurred when at least 80% of the fin was removed without cutting into the body on the dorsal surface of the fish. Tagged smolt were returned to the rearing unit following overnight mortality checks and held until release. Fish mortality was monitored daily and all mortalities were recorded.

Long-term tag retention was estimated for all release groups at least 30 days after tagging (Blankenship 1990). At least 750 adipose-clipped fish were randomly sampled from the population and checked for tag retention using a hand-held CWT detector. Long-term tag retention rate (D_j) of surviving smolt, and its variance, was also estimated as a binomial proportion (equations 1 and 2) for each group,

where:

n_i = number of smolt in the sample that retained the tag; and

n_{ti} = total number of tagged smolt in the sample.

The number of fish released with CWTs was estimated as:

$$\hat{T}_j = (N_j - M_j) \hat{D}_j, \quad (3)$$

and its variance as:

$$Var(\hat{T}_j) = (N_j - M_j)^2 Var(\hat{D}_j), \quad (4)$$

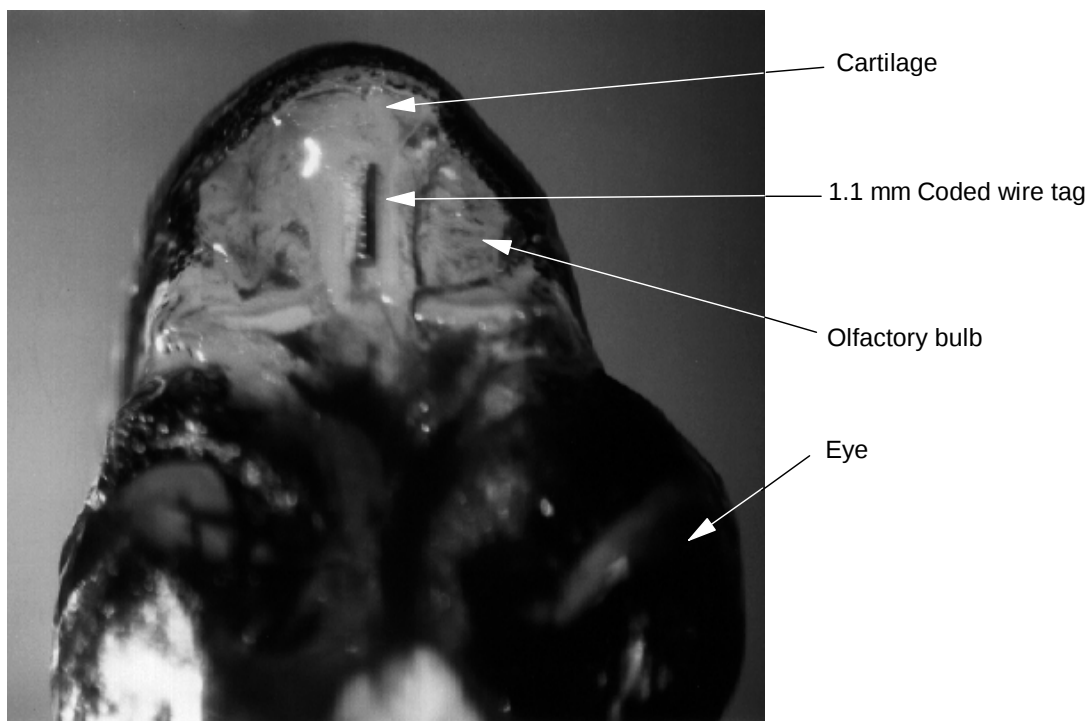
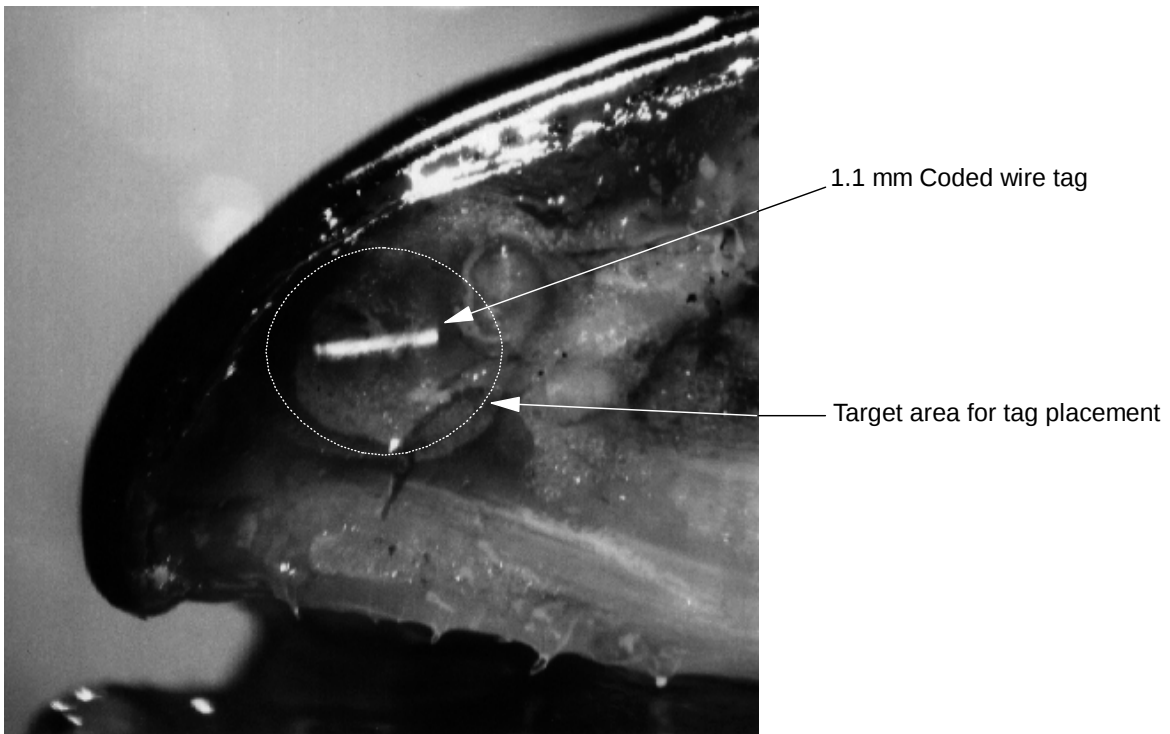


Figure 1.-Proper placement of a coded wire tag in a small fish.

where:

N_j = number of fish injected with a tag in group j ,

$\hat{D}_j$ = long-term tag retention of release group j , and

M_j = total number of mortalities of tagged fish in group j .

A minimum of 750 smolt per rearing unit was examined for adipose-clip quality within 7 days of release. Adipose clips were rated as acceptable or not acceptable.

Thermal Marking

Thermal marks were applied to all Chinook salmon embryos before hatching (Table 2). Thermal mark patterns were assigned by the Mark, Tag, and Age Laboratory operated by ADF&G Division of Commercial Fisheries. At approximately 360 cumulative temperature units (CTUs), which is the cumulative average daily temperature starting at fertilization in Centigrade, Chinook salmon otoliths were developed enough to accept a mark, as verified by the Mark, Tag, and Age Laboratory. Embryos were exposed to a series of 4-5°C water temperature changes (both increases and decreases), with each temperature decrease resulting in the deposit of a dark protein ring on the developing otolith (Monk *Unpublished*). Water temperature changes were scheduled every 24 hours, with a 72-hour warm water exposure occurring between bands of rings for Chinook salmon. The assigned patterns of dark protein rings applied to the otoliths (Figure 2) are used to identify the area of release from returning adult salmon. Onset Stowaway XTI data loggers recorded incubation water temperature every 15 minutes throughout the marking period to generate thermal profiles for each mark type (Figure 3). Voucher samples containing approximately 50 fish from each egg lot were collected before moving fish to the raceways (ponding) and submitted to the Mark, Tag, and Age Laboratory for mark verification.

Coho Salmon

Coho salmon were not thermally marked in 2003 because a warm water source was not available for marking.

Chinook Salmon

Chinook salmon were thermally marked in 2003 (Table 2). Different TMs consisting of two bands were applied to identify the fish as belonging to a Cook Inlet (2,3H), Prince William Sound (2,4H), or Resurrection Bay (2,5H) release group. The first band consisted of 2 rings, and the second band consisted of 3 rings for Cook Inlet, 4 for Prince William Sound, and 5 for Resurrection Bay.

Smolt Enumeration

The number of fish in all 21 release groups was estimated (before release) using either the TI counts, the HI abundance estimates, and/or the WV abundance estimates. The HI and WV estimates were compared to the three TI Chinook salmon release group counts to determine the precision of the HI and WV estimates. If the HI or WV estimates differed more than 10% from the TI count, then the estimates were reviewed.

Tagging Inventory

A TI count was obtained from the tag counter on the Mark IV CWT injector for the three Chinook salmon release groups 100% injected with CWTs. Thus, the number of injected tags

Table 2.-Summary of Chinook salmon thermal marks (hatch codes) for smolt stocked at 8 locations in Cook Inlet, 3 locations in Prince William Sound, and 2 locations in Resurrection Bay in 2005.

Mark Type	Broodstock	Release Group(s)	Hatch Code(s) ^a
Cook Inlet	Ship Creek	Ship Creek ^b	2,3H and 2,1,2H
Cook Inlet	Ship Creek	Eklutna Tailrace ^b	2,3H and 2,1,2H
Cook Inlet	Ninilchik River	Ninilchik River ^b	2,3H and 2,1,2H
Cook Inlet	Ninilchik River	Halibut Cove ^b	2,3H and 2,1,2H
Cook Inlet	Ninilchik River	Seldovia ^b	2,3H and 2,1,2H
Cook Inlet	Ninilchik River	Homer Spit ^b	2,3H and 2,1,2H
Prince William Sound	Deception Cr	Whittier ^c	No clear pattern
Prince William Sound	Deception Cr	Fleming Spit ^c	No clear pattern
Prince William Sound	Deception Cr	Valdez ^c	No clear pattern
Resurrection Bay	Crooked Cr	Lowell Creek ^c	No clear pattern
Resurrection Bay	Crooked Cr	Seward Lagoon ^c	No clear pattern
Cook Inlet	Deception Cr	Deception Cr ^d	3,2H
Cook Inlet	Crooked Creek	Crooked Cr ^d	3,2H

^a Hatch codes shown in boldface differ from the proposed release site hatch code.

^b Lost heat between marking rings 1 and 2 on second band. TM has multiple variants.

^c Lost cold water while marking 2nd band. TM has multiple variants.

^d Lost hot water resulting in extra ring on first band. Lost hot water missing last ring on second band.

equaled the number of fish in a release group. For these release groups, fish mortality was monitored daily and subtracted from the original TI count to yield a final fish count for each release group.

Hatchery Inventory Estimates

The HI abundance technique used at FRH was based on the weight of fish in a raceway. These estimates were obtained when fry were moved from small indoor raceways to large outdoor raceways. Approximately 10 randomly selected net loads of fish were used to estimate mean fish weight. Because a net full of fish was too large to enumerate (approximately 600-800 fish), the net was manually halved numerous times until 50-100 fish remained in the net. These fish were weighed and hand counted from a bucket to determine mean fish weight. The total weight of fish, obtained using the cumulative weight feature on the electronic scale, was then divided by the mean fish weight to establish the HI abundance estimate in that raceway. The number of fish released from an outdoor raceway equaled the original outdoor raceway estimate minus the fish stocked or transferred, and minus the mortalities from date of loading into the outdoor raceway to the date of release.

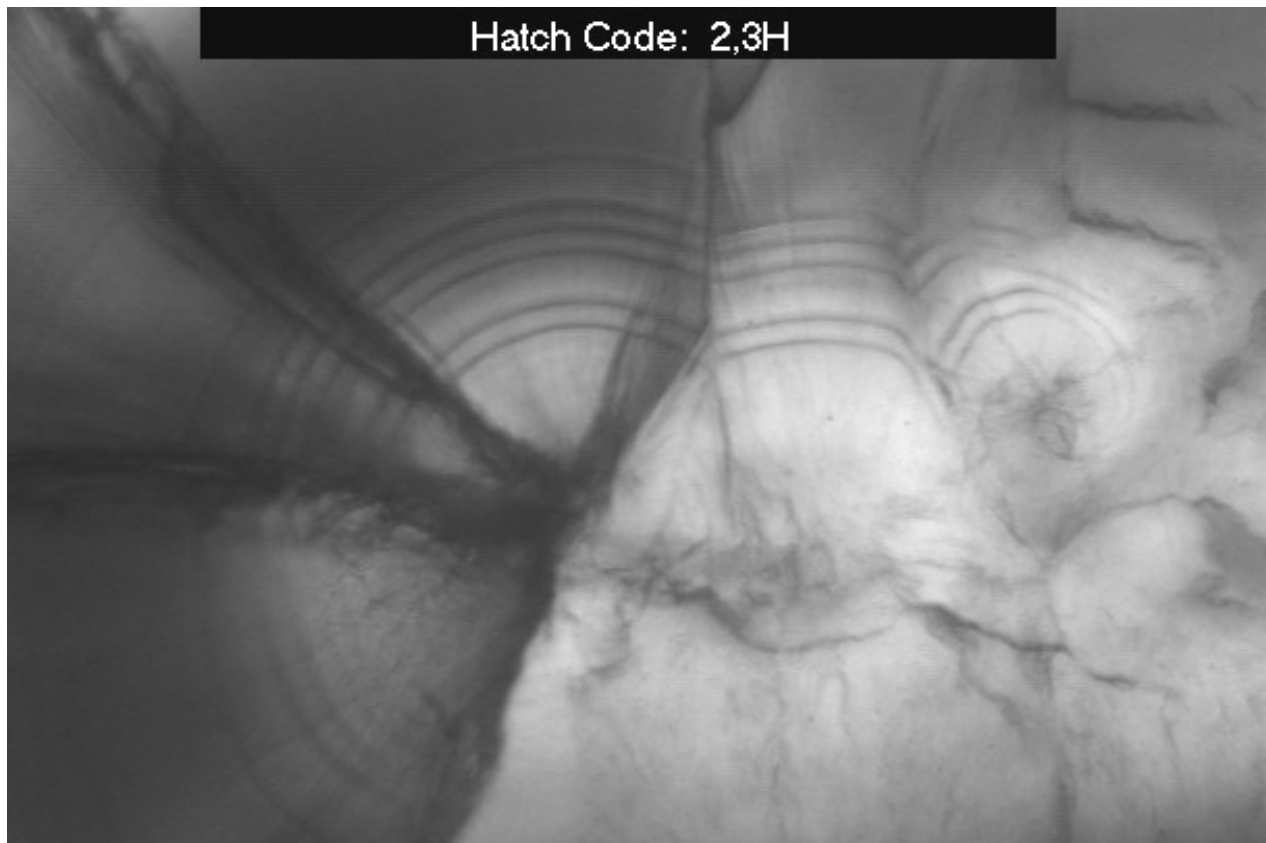


Figure 2.-Image of a thermal mark applied to Chinook salmon released into Cook Inlet in 2005.

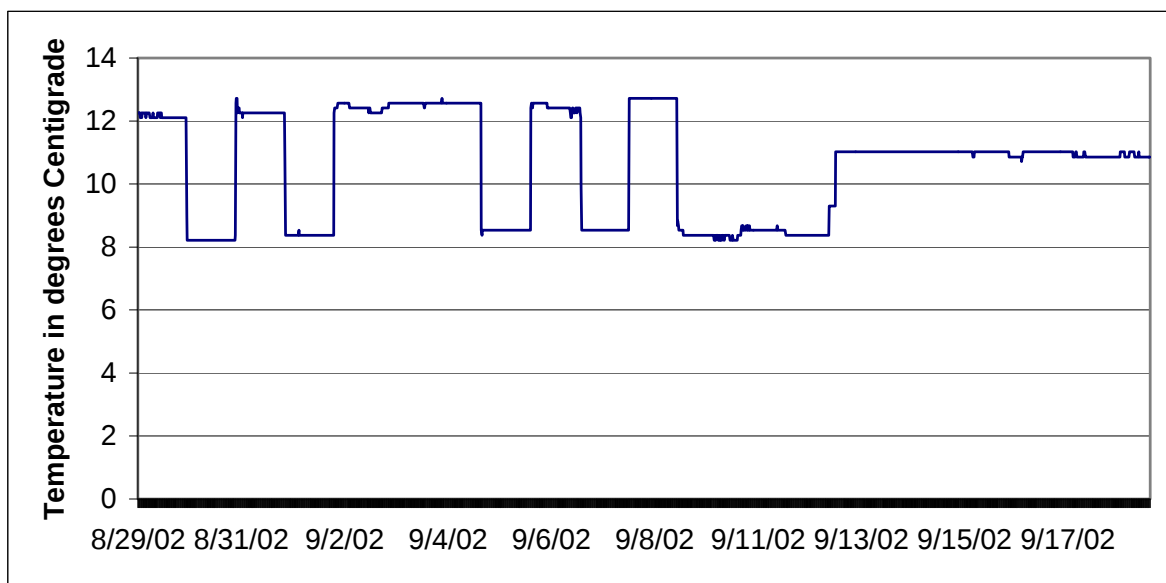


Figure 3.-Thermal marking temperature profile for Chinook salmon released into Cook Inlet in 2005 with a thermal mark (hatch code) of 2,3H.

Volumetric Estimates

Fish abundance (number or weight) was also estimated volumetrically at both hatcheries using a transport tank when transporting fish to the release location. This estimate is a function of the tank volume (gallons), the ratio of the volume of water displaced in the tank sight gauge to the volume of water placed in the tank (mm/gallon), and the ratio of the number (or weight) of fish which displace a volume of water in the tank sight gauge (fish/mm or kg/mm).

For fish transport, each tank was filled with water and the water level on the tank sight gauge recorded to the nearest millimeter. Fish were then pumped from the raceway into each of the transport tanks. The water level on the tank gauge was recorded again after fish were loaded into each of the tanks. The millimeters of water displaced for each tank were determined, and using a known displacement value of kilograms of fish per millimeter, the total weight of fish in the tank was estimated. Total number of fish was estimated by dividing the total fish weight by the mean fish weight.

FRH estimated mean weight by obtaining fish samples from five nets of fish before loading the tanks. Each net of fish was split in half several times until the desired sample size (50-100 fish) was achieved. The fish were poured into a pre-weighed bucket of water, weighed to the nearest gram, and counted out of the bucket. Mean weight was calculated for each of the five samples, and an overall mean weight was calculated by summing the five sample mean weights and dividing by the sum of the five fish counts.

EH estimated mean weight by removing three dip net samples of (50-100) fish from the transport tanks on the transport vehicle. Each net of fish was held out of the water for several seconds to allow for most of the water to drain out of the net. The fish from each sample were poured into a pre-weighed bucket of water, weighed to the nearest gram, and counted out of the bucket. Mean weights were calculated for each sample by dividing the sample weight by the number of fish in the sample, and an overall mean weight was calculated by summing the three sample mean weights and dividing by 3.

SIZE ESTIMATION

A sample of fish from each raceway containing CWTs and one raceway containing coho salmon (without CWTs) was individually weighed and measured. Fish were crowded to one end of the raceway and a minimum of 510 was dipnetted and put into a small holding pen. Each fish in the holding pen was measured to the nearest millimeter using an electronic fish measuring board, and weighed to the nearest 0.1 g on an electronic scale.

RESULTS

SMOLT MARKING

Coded Wire Tagging

There were 331,858 Chinook salmon smolt with an adipose clip and a CWT released in Cook Inlet in 2005 (Table 3). The goal of marking all Chinook salmon in three release groups with an adipose clip and a CWT was achieved.

Long-term tag retention was determined 50-108 days after tagging (Table 3). Tag retention rates ranged from 99.4 to 99.9% (Table 3).

Table 3.-Summary of coded wire tagging data and smolt release estimates for Chinook salmon stocked in Cook Inlet, 2005.

Release site parameter	Chinook Salmon				Totals
	Deception Creek	Deception Creek	Ninilchik River	Crooked Creek	
Tag codes	31-03-28 31-03-29 31-03-30	31-03-30 31-03-31	31-03-41	31-03-39 31-03-40 31-03-17	
Initial number of fish with adipose clip and CWT	112,390	50,814	55,266	113,880	332,350
Mortalities	105	83	37	267	492
Acceptable adipose clip	99.1%	99.9%	99.2%	99.5%	
Adipose-clipped fish released	111,325	50,666	54,806	113,071	329,869
Tag retention sample size	819	782	813	839	
Tag retention at release	99.6%	99.7%	99.4%	99.9%	99.7%
Tag retention variance	4.4616E-06	3.26633E-06	7.52739E-06	1.4206E-06	
Tagged fish released	111,836	50,579	54,898	113,499	330,812
Tagged fish variance	55,294	8,385	22,610	18,163	
Total fish released (tagging inventory)	112,285	50,731	55,229	113,613	331,858
Tagging dates	2/1/2005 2/18/2005	2/18/2005 2/28/2005	3/18/2005 3/29/2003	2/28/2005 3/17/2005	
Date of tag retention check	6/6/2005	6/1/2005	5/18/2005	5/31/2005	
Days elapsed	108	93	50	75	

Acceptable adipose fin removal rates ranged from 99.1 to 99.9% per raceway. Fish without adipose clips and lacking a CWT were found in three raceways (Crooked Creek: 1 of 839 fish examined, Deception Creek (a): 14 of 796 fish examined, Deception Creek (b): 2 of 821 fish examined). The 17 fish without adipose clips were not included in the quality control rate calculations.

Thermal Marking

A heated water source was not available for the 2003 coho salmon thermal marking. Therefore, coho salmon released in 2005 lack TMs. The Ship Creek Chinook salmon broodstock released from EH were surplus to the landlocked lakes salmon stocking program and also lacked TMs.

Thermal profiles and digital images of FRH Chinook salmon TMs indicate that most, and possibly all, fish in each release group received a TM that differed from the planned TM (Table 2, Appendix A2) because of mechanical problems during marking. As a result, TMs for the three Prince William Sound and two Resurrection Bay release groups exhibited no clear pattern, TMs for six Cook Inlet release groups exhibited multiple patterns, and TMs for the two other Cook Inlet release groups differed from the intended mark.

SMOLT RELEASES

In 2005, 21 coho and Chinook salmon release groups were stocked in Cook Inlet, Prince William Sound, and Resurrection Bay release areas (Table 1). FRH released an estimated 934,799 coho salmon smolt at 7 locations and an estimated 1,852,756 Chinook salmon smolt at 13 locations (Table 1). EH released an estimated 13,838 Chinook salmon at one location (Table 1).

SMOLT ENUMERATION

HI estimates were reported for the seven coho salmon release groups (934,799 smolt) and 10 Chinook salmon release groups (1,520,898 smolt) (Table 1). A WV displacement estimate of 13,838 smolt was reported for the one Chinook salmon release group from EH. TI counts were reported and compared to the results of HI and WV displacement estimation techniques for the three TI Chinook salmon release groups (331,858 smolt) (Table 4). The precision of the HI and WV displacement estimates were within 5% of the three TI Chinook salmon release group counts (Table 4).

Table 4.-A comparison of hatchery inventory and water volume population estimates to a tagging inventory count for four units of Chinook salmon reared at Fort Richardson Hatchery.

Estimation technique	Deception Cr B2	Deception Cr C3	Ninilchik R	Crooked Cr
Tagging Inventory Count	112,285	50,731	55,229	113,613
Hatchery Inventory (weight)	114,934	49,249	54,960	115,533
WV Displacement	115,976	51,923	57,888	112,667
Difference TI to HI	2.3%	-3.0%	-0.5%	1.7%
Difference TI to WV	3.2%	2.3%	4.6%	-0.8%
Difference HI (weight) to WV	0.9%	5.1%	5.1%	-2.5%

SIZE ESTIMATION

The production goal for coho salmon was to have 80% of the fish weigh between 15.1 and 25.0 g. The one coho salmon release group sampled (Campbell Creek) for weight did not achieve the production goal (68.5%, Table 5, Figure 4). The production goal for Chinook salmon was to have 80% of the fish weigh between 5.1 and 15.0 g. All three Chinook salmon release groups achieved the production goal (Crooked Creek = 80.5%, Deception Creek = 82.1%, Ninilchik River = 82.4%) (Table 5, Figure 4).

Table 5.-The percentage of Chinook salmon in CWT release groups and in a single coho salmon release group from Fort Richardson Hatchery in 2005 that are within, smaller than, and larger than the production goal's target size range.

Release group	Percent		
	Below	Within	Above
Coho Salmon ^a			
Campbell Creek	11.2%	68.5%	20.3%
Chinook Salmon ^b			
Deception Creek	0.1%	82.1%	17.8%
Ninilchik River	0.0%	82.4%	17.6%
Crooked Creek	0.0%	80.5%	19.5%

^a Production goal for coho salmon: 80% of smolts 15.1-25.0 g.

^b Production goal for Chinook salmon: 80% of smolts 5.1-15.0 g.

DISCUSSION

SMOLT MARKING

Coded Wire Tagging

A point of emphasis for the CWT marking program has been to achieve good long-term tag retention rates. Overall long-term tag retention in 2005 was 99.7%. Grading fish and using different sizes of head molds for tagging is responsible for maintaining acceptable (>97%) long-term tag retention rates.

Managers use adipose clips on hatchery-released fish to manage sport fisheries that target adult Chinook salmon returning to the Ninilchik and Kasilof rivers. Properly clipped fins are essential so that anglers and enforcement officials can distinguish between hatchery and non-hatchery fish.

This was the first year adipose-clip rates were formally evaluated. While removing 80% of the adipose fin clearly identifies clipped smolt, it is not known if partial or complete fin regeneration occurs in adults retaining 20% of the fin.

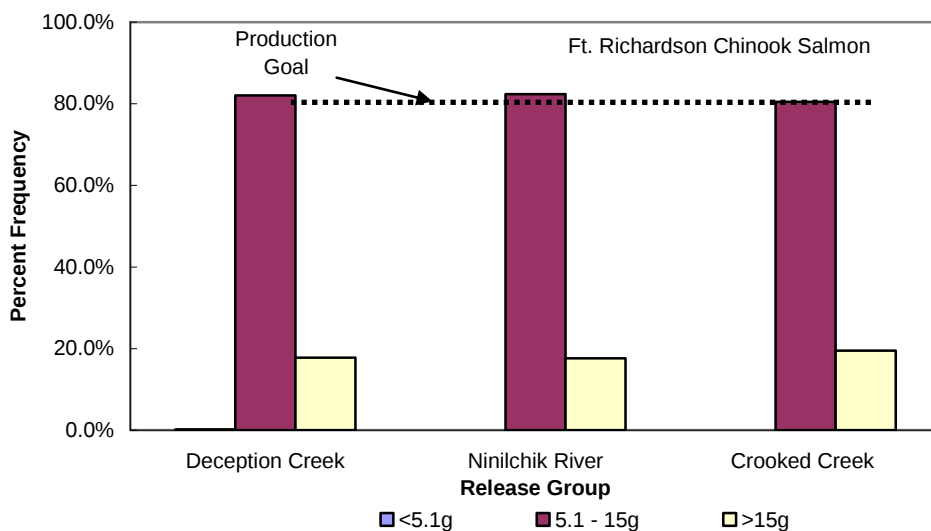
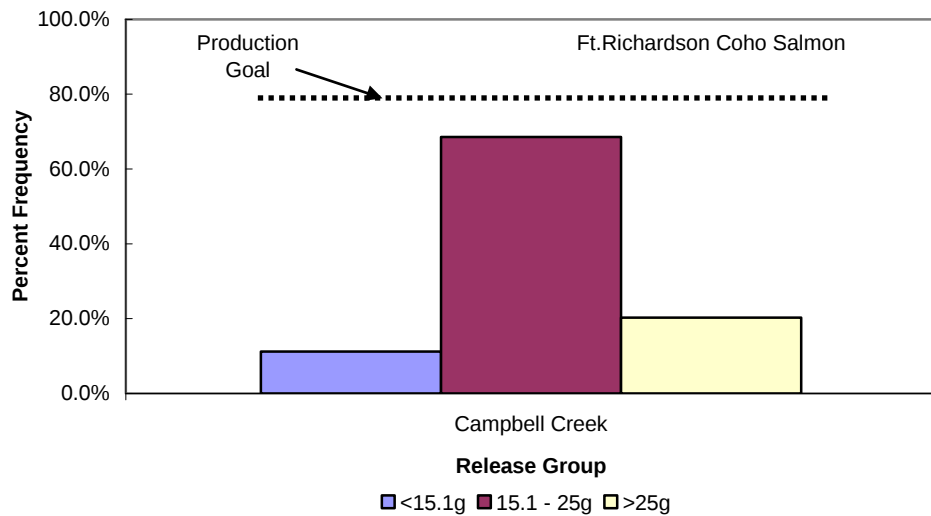


Figure 4.-Weight distributions, mean weights, and production goal target weight range, for Chinook and coho salmon reared at Fort Richardson Hatchery and released in 2005.

Thompson and Blankenship (1997) found no fin regeneration in returning adult coho salmon when adipose fins were entirely removed at 12 months of age. When only the posterior two-thirds or the top two-thirds of the fin were removed, complete fin regeneration occurred in 23% of the fish. Partial fin regeneration occurred in 35% of the fish when the posterior two-thirds were removed, and in 63% of the fish when the top two-thirds were removed. Returning adults with partially regenerated adipose fins might not be identified as hatchery fish.

The Crooked Creek and Deception Creek release groups contained 17 fish without adipose clips and CWTs at release. Two screens were used to separate adipose-clipped fish from unclipped fish within the raceways during tagging (Figure 5). Although it is not known how the unmarked fish got into the two raceways, they likely jumped the screens, jumped from adjacent raceways, or were misplaced during tagging. The consistent use of “jump” screens could reduce the mixing of marked and unmarked fish in the future.

Thermal marking

Warmwater effluent from the Fort Richardson power plant was used to heat FRH water to attain the 4°C temperature differential needed to apply TMs. However, unstable effluent temperatures and the loss of a coldwater well during the Chinook salmon thermal marking altered TMs for each Chinook salmon release group. Thermal marking of coho salmon did not occur in 2005 because warm water from the power plant was no longer available and a replacement warm water source (i.e., water boiler) had not yet been installed. Consequently, thermal marks cannot be used to identify the origin of these fish.

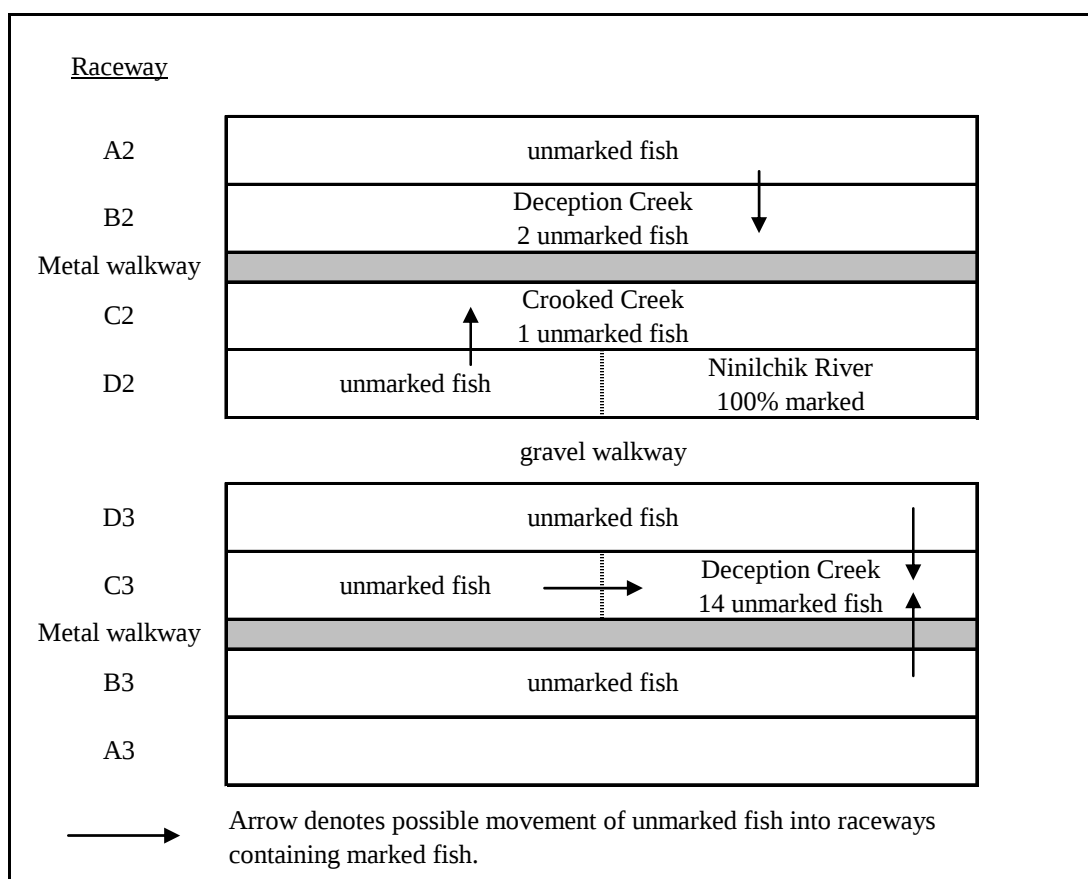


Figure 5.-Diagram of Chinook salmon rearing units at Fort Richardson Hatchery depicting location of rearing units with 100% marked fish and rearing units with unmarked fish.

SMOLT ENUMERATION

Peltz and Hansen (1994) reported that numerous sources of error associated with water displacement values make the WV displacement method of estimating populations unreliable. They recommended this method be used only when other estimation methods cannot be used or when accuracy is not important. Because the Chinook salmon released from EH were only a portion of a raceway's population, the WV population estimation method was the most efficient.

For each of the four Chinook salmon rearing units, the HI estimates were within 3% of the TI counts, and the TI counts and WV estimates were within 4.6% of each other. Improved techniques based on the weight of fish in each release group since 1997 have made the HI method as reliable as the mark-recapture method at FRH and EH (Starkey et al. 1999). Improved transport tank loading techniques such as avoiding the addition of unmeasured water when loading fish in the tanks and taking accurate site gauge readings likely account for the increased reliability of WV estimates.

SIZE ESTIMATION

To maximize ocean survival and maintain the age composition of the population, Peltz and Starkey (1993) recommended that 80% of hatchery coho salmon smolt weigh between 15.1 and 25.0 g, and hatchery Chinook salmon weigh between 5.1 and 15.0 g at release. The larger than recommended release size for the Campbell Creek coho salmon release group may increase the number of age-.1 jacks returning there in 2006.

RECOMMENDATIONS

1. All fish should be graded and tagged using the appropriate head mold sizes.
2. Continue proper tag placement to maintain acceptable (>97%) long-term retention rates for all groups.
3. Continue to monitor adipose-clip quality during tagging and at release.
4. Temperature changes of 4–5°C should occur every 24 hours between rings, and every 72 hours between bands of rings during thermal marking.
5. Follow the production goal size at release recommendations that 80% of coho salmon weigh between 15.1 g and 25.0 g, and 80% of Chinook salmon weigh between 5.1 g and 15.0 g.
6. Continue to record individual bucket weights when performing hatchery inventory procedures in case of electronic scale failure.

ACKNOWLEDGMENTS

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APPENDIX A

Appendix A1.-Historical releases of coho salmon that were adipose clipped and tagged with coded wire tags, and/or thermally marked.

					Total Released		Coded Wire Tagged			Thermal Marking	
Brood			Release			Type of	Clipped	Tagged		Mark	Hatch
Year	Broodstock	Hatchery	Year	CWT Code	Estimate	Estimate ^a	Fish Released	Fish Released	Percent tagged	Group	Code
Anchorage Urban Streams ^b											
1994	Little Susitna	Ft Richardson	1996	31-25-06	302,857	M-R	93,975	92,565	30.56%		
Bird Creek											
1990	Little Susitna	Ft Richardson	1992	31-20-02 31-20-03	95,377	M-R	44,903	37,629	39.50%		
1991	Little Susitna	Ft Richardson	1993	31-21-39	140,382	M-R	43,441	42,350	30.20%		
1992	Little Susitna	Ft Richardson	1994	31-23-02	84,643	M-R	45,220	44,686	52.80%		
1993	Little Susitna	Ft Richardson	1995	31-23-37	154,753	M-R	45,666	45,490	29.40%		
1994	Little Susitna	Ft Richardson	1996	31-25-04	147,618	M-R	46,528	45,411	30.80%		
1995	Little Susitna	Ft Richardson	1997	31-26-01	146,612	HI	45,901	45,488	31.03%		
1995	Little Susitna	Ft Richardson	1997	31-26-27	147,953	HI	45,836	45,469	30.73%		
1996	Little Susitna	Ft Richardson	1998	31-26-25	164,211	HI	46,140	46,094	28.07%		
1997	Ship Cr (Little Susitna)	Ft Richardson	1999	31-26-15	111,430	EC	37,344	36,746	32.98%		
1998	Ship Cr (Little Susitna)	Ft Richardson	2000	31-01-43	97,409	EC	40,114	39,392	40.44%		
2002	Ship Cr (Little Susitna)	Ft Richardson	2004		109,949	HI				Cook Inlet	5H
2003	Ship Cr (Little Susitna)	Ft Richardson	2005 ^c		100,605	HI					
Campbell Creek ^b											
1990	Little Susitna	Ft Richardson	1992	31-20-04 31-20-05	97,076	M-R	43,681	39,444	40.60%		
1991	Little Susitna	Ft Richardson	1993	31-21-38	140,797	M-R	43,440	42,916	30.50%		
1992	Little Susitna	Ft Richardson	1994	31-23-03	87,686	M-R	44,144	42,963	49.00%		
1993	Little Susitna	Ft Richardson	1995	31-23-36	157,241	M-R	45,655	44,995	28.60%		
1995	Little Susitna	Ft Richardson	1997	31-25-62	71,519	TI	45,840	45,290	63.33%		
1996	Little Susitna	Ft Richardson	1998	31-26-52	83,317	HI	22,453	22,296	26.76%		
1997	Ship Cr (Little Susitna)	Ft Richardson	1999	31-01-30	42,046	EC	20,879	20,378	48.47%		
1998	Ship Cr (Little Susitna)	Ft Richardson	2000	31-02-30	63,730	EC	19,948	19,549	30.67%		
1999	Ship Cr (Little Susitna)	Ft Richardson	2001	31-02-32	69,836	HI	21,568	20,813	29.80%		

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					Total Released		Coded Wire Tagged			Thermal Marking	
Brood			Release			Type of	Clipped	Tagged		Mark	Hatch
Year	Broodstock	Hatchery	Year	CWT Code	Estimate	Estimate ^a	Fish Released	Fish Released	Percent tagged	Group	Code
Campbell Creek^b (continued)											
2000	Ship Cr (Little Susitna)	Ft Richardson	2002	31-01-97	61,323	HI	22,789	21,672	35.34%	Cook Inlet	5H
2001	Ship Cr (Little Susitna)	Ft Richardson	2003		78,576	HI				Cook Inlet	5H
2002	Ship Cr (Little Susitna)	Ft Richardson	2004		85,790	HI				Cook Inlet	5H
2003	Ship Cr (Little Susitna)	Ft Richardson	2005 ^c		60,387	HI					
Cottonwood Creek											
1990	Fish Creek	Big Lake	1992	31-20-08 31-21-09	53,900	M-R	35,341	32,938	61.10%		
1991	Fish Creek	Big Lake	1993	31-21-41	74,198	M-R	43,117	40,875	55.10%		
Eklutna Tailrace											
1996	Jim Creek	Ft Richardson	1998	31-26-27 31-26-54, 55,56	112,219	TI	112,219	111,882	99.70%		
1997	Jim Creek	Ft Richardson	1999	31-26-16	126,602	EC	44,073	42,663	33.70%		
1998	Jim Creek	Ft Richardson	2000	31-01-46	76,851	EC	40,514	40,149	52.24%		
1999	Eklutna Tailrace	Ft Richardson	2001	31-02-47	124,838	HI	43,713	43,494	34.84%		
2000	Eklutna Tailrace	Ft Richardson	2002	31-02-46	120,629	HI	44,518	44,295	36.72%	Cook Inlet	5H
2001	Eklutna Tailrace	Ft Richardson	2003		120,736	HI				Cook Inlet	5H
2002	Eklutna Tailrace	Ft Richardson	2004		131,979	HI				Cook Inlet	5H
2003	Eklutna Tailrace	Ft Richardson	2005 ^c		132,149	HI					
Fish Creek											
1990	Fish Creek	Big Lake	1992	31-20-12 31-20-13	74,953	M-R	45,538	43,625	58.20%		
1991	Fish Creek	Big Lake	1993	31-21-40	67,934	M-R	44,050	43,257	63.70%		

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					Total Released		Coded Wire Tagged			Thermal Marking	
Brood			Release			Type of	Clipped	Tagged		Mark	
Year	Broodstock	Hatchery	Year	CWT Code	Estimate	Estimate ^a	Fish Released	Fish Released	Percent tagged	Group	Hatch Code
Homer Spit											
1996	Bear Lake	Elmendorf	1998	31-26-28	130,219	M-R	42,057	41,926	32.20%		
1997	Bear Lake	Elmendorf	1999	31-01-40	129,602	M-R	44,405	43,020	33.19%		
	Bear Lake	Elmendorf	2000-01 ^c								
		Ft Richardson									
1999	Ship Cr (Little Susitna)	Ft Richardson	2001	31-01-36	100,280	HI	44,992	44,812	44.69%		
2000	Ship Cr (Little Susitna)	Ft Richardson	2002	31-01-98	95,648	HI	45,498	44,179	46.19%	Cook Inlet	5H
2000	Bear Lake	Ft Richardson	2002		120,707	HI				Cook Inlet	5H
2001	Ship Cr (Little Susitna)	Ft Richardson	2003		222,935	HI				Cook Inlet	5H
2002	Ship Cr (Little Susitna)	Ft Richardson	2004		130,243	HI				Cook Inlet	5H
2003	Ship Cr (Little Susitna)	Ft Richardson	2005 ^c		125,707	HI					
Little Susitna at Houston											
1990	Little Susitna	Ft Richardson	1992	31-20-07	154,466	M-R	21,884	19,564	12.70%		
1991	Little Susitna	Ft Richardson	1993	31-21-37	148,282	M-R	21,404	20,312	13.70%		
Lowell Creek											
2000	Bear Lake	Ft Richardson	2002		119,512	HI				Resurrection Bay	4H
2001	Bear Lake	Ft Richardson	2003		124,389	HI				Resurrection Bay	4H
2002	Bear Lake	Ft Richardson	2004		131,989	HI				Resurrection Bay	4H
2003	Bear Lake	Ft Richardson	2005 ^c		132,276	HI					
Nancy Lake											
1990	Little Susitna	Ft Richardson	1992	31-20-06	158,459	M-R	21,598	19,222	12.10%		
1991	Little Susitna	Ft Richardson	1993	31-21-37	131,591	M-R	21,001	19,930	15.20%		
1992	Little Susitna	Ft Richardson	1994	31-23-01	126,694	M-R	44,489	43,818	34.60%		
1993	Little Susitna	Ft Richardson	1995	31-23-39	151,985	M-R	46,261	45,245	29.80%		

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					Total Released		Coded Wire Tagged			Thermal Marking	
Brood			Release			Type of	Clipped	Tagged			
Year	Broodstock	Hatchery	Year	CWT Code	Estimate	Estimate ^a	Fish Released	Fish Released	Percent tagged	Mark Group	Hatch Code
Seward Lagoon											
2000	Bear Lake	Ft Richardson	2002		121,743	HI				Resurrection Bay	4H
2001	Bear Lake	Ft Richardson	2003		123,718	HI				Resurrection Bay	4H
2002	Bear Lake	Ft Richardson	2004		131,798	HI				Resurrection Bay	4H
2003	Bear Lake	Ft Richardson	2005 ^c		132,229	HI					
Ship Creek ^b											
1990	Ship Creek	Elmendorf	1992	31-19-63 31-20-01	67,178	TI	44,086	38,443	57.20%		
1991	Ship Creek	Elmendorf	1993	31-21-36	54,764	TI	42,112	41,322	75.50%		
1992	Ship Creek	Elmendorf	1994	31-23-04	75,779	TI	44,031	41,722	55.10%		
1993	Little Susitna	Ft Richardson	1995	31-23-38	158,981	M-R	45,491	44,654	28.10%		
1995	Little Susitna	Ft Richardson	1997	31-25-63	232,066	TI,HI	45,925	45,741	19.71%		
1996	Little Susitna	Ft Richardson	1998	31-26-53 31-26-26	232,765	HI	67,812	66,997	28.78%		
1997	Ship Cr (Little Susitna)	Ft Richardson	1999	31-26-14 31-01-29	165,388	EC	48,299	45,380	27.44%		
1998	Ship Cr (Little Susitna)	Ft Richardson	2000	31-01-32 31-01-33	260,070	EC	61,640	58,989	22.68%		
1999	Ship Cr (Little Susitna)	Ft Richardson	2001	31-02-61	233,563	HI	64,165	61,663	26.40%		
2000	Ship Cr (Little Susitna)	Ft Richardson	2002	31-02-83	212,639	HI	67,959	63,678	29.95%	Cook Inlet	5H
2001	Ship Cr (Little Susitna)	Ft Richardson	2003	31-02-74, 31-02-69	234,716	HI	64,234	64,125	27.32%	Cook Inlet	5H
2002	Ship Cr (Little Susitna)	Ft Richardson	2004	31-02-81, 31-03-15	241,066	HI	63,222	62,906	26.09%	Cook Inlet	5H
2003	Ship Cr (Little Susitna)	Ft Richardson	2005 ^c		251,446	HI					

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					Total Released		Coded Wire Tagged			Thermal Marking	
Brood		Hatchery	Release		Estimate	Type of Estimate ^a	Clipped	Tagged	Percent tagged	Mark Group	Hatch Code
Year	Broodstock		Year	CWT Code			Fish Released	Fish Released			
Wasilla Creek											
1990	Fish Cr	Big Lake	1992	31-20-10	76,315	M-R	44,148	41,985	55.00%		
				31-20-11							
1991	Fish Cr	Big Lake	1992	31-21-42	77,174	M-R	43,001	41,711	54.10%		
1994	Little Susitna	Ft Richardson	1996	31-25-05	145,923	M-R	46,980	46,839	32.10%		

^a M-R is mark-recapture; TI is tagging inventory count; HI is hatchery inventory count; EC is electronic count.

^b Campbell and Ship creeks were combined and termed "Anchorage Urban Streams" in 1996.

^c Stocking continued, but releases did not contain tagged or thermally marked fish.

Appendix A2.-Historical releases of Chinook salmon that were adipose clipped and tagged with coded wire tags, and/or thermally marked.

				Total Released			Coded Wire Tagging			Thermal Marking	
Brood			Release			Type of	Clipped	Tagged	Percent		
Year	Broodstock	Hatchery	Year	CWT Code	Estimate	Estimate ^a	Fish Released ^b	Fish Released	Tagged	Mark Group	Hatch Code
Buskin River											
1994	Deception Cr	Elmendorf	1995	31-24-31	84,349	M-R	41,572	41,078	48.70%		
1995	Deception Cr	Elmendorf	1996	31-25-09	113220	M-R	41259	40681	35.90%		
Crooked Creek											
1993	Crooked Cr	Elmendorf	1994	31-23-14	224,784	M-R	43,609	43,034	19.10%		
1994	Homer ^c	Elmendorf	1995	31-24-27	184,049	M-R	40,903	38,420	20.90%		
1995	Homer ^c	Elmendorf	1996	31-25-12	193,180	M-R	40,827	40,196	20.80%		
1996	Homer ^c	Elmendorf	1997	31-25-55	223,200	M-R	41,049	39,038	17.49%		
1997	Homer ^c	Elmendorf	1998	31-26-29	137,338	M-R	42,874	42,610	31.03%		
1998	Homer ^{c,d}	Elmendorf	1999	31-01-41	192,304	M-R	43,431	42,649	22.17%		
1999	Crooked Cr	Elmendorf	2000	31-02-31, 31-01-34,35	108,507	TI	108,507	105,578	97.30%		
2000	Crooked Cr	Elmendorf	2001	31-01-95, 31-02-36,37	109,201	TI	109,201	107,454	98.40%		
2001	Crooked Cr	Elmendorf	2002	31-02-51,31-01-96,99	99,547	TI	99,547	98,452	98.90%	Crooked Cr	2,4H4e
2002	Crooked Cr	Ft Richardson	2003	31-02-72, 73, 68	98,800	TI	98,800	94,058	95.20%	Cook Inlet	2,3H
2002	Crooked Cr	Ft.Richardson	2004	31-02-79, 80	80,601	TI	80,601	75,120	93.2%	Cook Inlet	2,3H
2003	Crooked Cr	Ft.Richardson	2005	31-03-39, 40, 17	113,613	TI	113,071	113,499	99.9%	Cook Inlet	2,3H ^f

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			Total Released				Coded Wire Tagging			Thermal Marking	
Brood			Release		Type of		Clipped	Tagged	Percent		
Year	Broodstock	Hatchery	Year	CWT Code	Estimate	Estimate ^a	Fish Released ^b	Fish Released	Tagged	Mark Group	Hatch Code
Deception Creek											
1991	Deception Cr	Ft Richardson	1992	31-21-03	179,724	M-R	44,089	33,464	18.60%		
1992	Deception Cr	Ft Richardson	1993	31-21-60	160,194	M-R	42,782	39,420	24.60%		
1993	Deception Cr	Ft Richardson	1994	31-23-17	177,913	M-R	46,289	45,921	25.80%		
1994	Deception Cr	Ft Richardson	1995	31-24-34	184,740	M-R	46,807	46,256	25.00%		
1995	Deception Cr	Ft Richardson	1996	31-25-14	186,918	M-R	47,700	47,145	25.20%		
1996	Deception Cr	Ft Richardson	1997	31-26-03,04,05,06,07	209,644	TI	209,644	207,973	99.20%		
1997	Deception Cr	Ft Richardson	1998	31-25-32	197,392	TI	197,392	195,615	99.10%		
1998	Deception Cr	Ft Richardson	1999	31-26-17,18,19, 20 31-01-31	201,586	TI	201,586	199,722	99.08%		
1999	Deception Cr	Ft Richardson	2000	31-26-21, 31-01-44,31-02 33,34,35	206,496	TI	206,496	205,051	99.30%		
2000	Deception Cr	Ft Richardson	2001	31-02-41,42,43,44,45	207,465	TI	207,465	204,560	98.60%		
2001	Deception Cr	Ft Richardson	2002	31-01-92,31-02-52, 53,54,55	197,277	TI	197,277	196,608	99.66%	Deception Cr	2,5H
2002	Deception Cr	Ft Richardson	2003	31-02-70, 71, 31-01-94	101,181	TI	101,181	99,562	98.40%	Cook Inlet	2,3H
2002	Deception Cr	Ft Richardson	2004	31-02-77, 78, 31-03-16	113,523	TI	113,523	104,101	91.70%	Cook Inlet	2,3H ^f
2003	Deception Cr	Ft Richardson	2004	31-02-75, 76, 31-01-27	99,047	TI	99,047	97,660	98.60%	Cook Inlet	2,3H
2003	Deception Cr	Ft Richardson	2005	31-03-28,29,30,31	163,016	TI	161,991	162,415	99.63%	Cook Inlet	2,3H ^g
Eagle River											
1993	Ship Creek	Elmendorf	1994	31-23-13	98,872	M-R	43,612	41,669	42.10%		
Eklutna Tailrace											
2001	Ship Creek	Elmendorf	2002		106,991	VOL				Eklutna Tailrace	2,3H3
2002	Ship Creek	Ft Richardson	2003		218,492	HI				Cook Inlet	2,3H
2002	Ship Creek	Ft Richardson	2004		215,165	HI				Cook Inlet	2,3H ^f
2003	Ship Creek	Ft Richardson	2005		164,586	HI				Cook Inlet	2,3H ^g

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				Total Released		Coded Wire Tagging			Thermal Marking		
Brood			Release			Type of	Clipped	Tagged	Percent		
Year	Broodstock	Hatchery	Year	CWT Code	Estimate	Estimate ^a	Fish Released ^b	Fish Released	Tagged	Mark Group	Hatch Code
Fleming Spit											
1998	Deception Cr	Ft. Richardson	1999	31-26-23	49,773	TI	45,705	45,385	91.18%		
1999	Deception Cr	Elme ndorf	2000	31-01-38	45,000	V IS	17,358	17,236	38.30%		
2000	Deception Cr	Elme ndorf	2001	31-02-38	94,812	HI	40,659	40,415	42.63%		
2001	Deception Cr	Ft. Richardson	2002	31-02-57	109,656	HI	40,054	39,573	36.09%	Prince William Sound	2,4H
2002	Deception Cr	Ft. Richardson	2003		109,757	HI				Prince William Sound	2,4H
2003	Deception Cr	Ft. Richardson	2004		58,000	HI				Prince William Sound	2,4H
2003	Deception Cr	Ft. Richardson	2005		87,591	HI				Prince William Sound	2,4H [§]
Halibut Cove											
1993	Crooked Creek	Elme ndorf	1994	31-23-15	98,872	M-R	21,205	21,038	21.30%		
1994	Ninilchik River	Elme ndorf	1995	31-24-30	37,577	M-R	36,944	36,700	97.70%		
1995	Ninilchik River	Elme ndorf	1996	31-25-11	97,729	M-R	40,688	39,345	40.30%		
1996	Ninilchik River	Elme ndorf	1997	31-25-58	78,133	M-R	40,919	39,487	50.54%		
1997	Ninilchik River	Elme ndorf	1998	31-26-32	65,893	M-R	38,476	38,041	57.73%		
	Ninilchik River	Elme ndorf	1999-01 ^h								
2001	Ninilchik River	Elme ndorf	2002		106,279	VOL				Kachemak Bay	2,4H3
2002	Ninilchik River	Ft Richardson	2003		106,844	HI				Cook Inlet	2,3H
2002	Ninilchik River	Ft Richardson	2004		103,771	HI				Cook Inlet	2,3H
2003	Ninilchik River	Ft Richardson	2005		112,521	HI				Cook Inlet	2,3H [§]
Homer Spit (early run)											
1993	Crooked Creek	Elme ndorf	1994	31-23-16	163,963	M-R	26,003	25,615	15.60%		
1994	Homer ^c	Elme ndorf	1995	31-24-32	216,026	M-R	41,650	40,291	18.70%		
1995	Homer ^c	Elme ndorf	1996	31-25-07	204,085	M-R	40,868	39,017	19.10%		
1996	Homer ^c	Elme ndorf	1997	31-25-60	217,773	M-R	41,112	38,810	17.82%		
1997	Homer ^c	Elme ndorf	1998	31-26-33	177,730	M-R	40,012	39,652	22.31%		
1998	Homer ^c	Elme ndorf	1999	31-01-45	163,170	M-R	42,561	40,423	24.77%		
	Ninilchik River	Elme ndorf	2000-01 ^h								
2001	Ninilchik River	Elme ndorf	2002		190,026	VOL				Kachemak Bay	2,5H3
2002	Ninilchik River	Ft Richardson	2003		206,292	HI				Cook Inlet	2,3H
2002	Ninilchik River	Ft Richardson	2004		143,037	HI				Cook Inlet	2,3H
2003	Ninilchik River	Elme ndorf	2004		25,706	VOL				Cook Inlet	2,3H
2003	Ninilchik River	Ft Richardson	2005		220,822	HI				Cook Inlet	2,3H [§]

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				Total Released		Coded Wire Tagging			Thermal Marking		
Brood			Release			Type of	Clipped	Tagged			
Year	Broodstock	Hatchery	Year	CWT Code	Estimate	Estimate ^a	Fish Released ^b	Fish Released	Percent Tagged	Mark Group	Hatch Code
Homer Spit (late run)											
1992	Kasilof River	Crooked Creek	1994	31-23-19	56,920	M-R	22,612	22,383	39.30%		
1994	Homer ^j	Elmendorf	1995	31-24-33	123,048	M-R	41,054	40,466	32.90%		
1995	Homer ^j	Elmendorf	1996	31-25-13	108,204	M-R	40,615	38,787	35.80%		
1996	Homer ^j	Elmendorf	1997	31-25-61	100,933	M-R	41,028	39,264	38.90%		
1997	Homer ^j	Elmendorf	1998	31-26-34	112,100	HI	40,158	39,997	35.68%		
	Homer ^j	Elmendorf	1999 ^h								
Lowell Creek											
1996	Deception Cr	Elmendorf	1997	31-25-59	102,147	M-R	40,906	40,497	39.65%		
	Deception Cr	Elmendorf	1998-99 ^h								
	Crooked Creek	Elmendorf	2000-01 ^h								
2001	Crooked Creek	Elmendorf	2002		93,296	VOL				Resurrection Bay	2,5H3
2002	Crooked Creek	Ft Richardson	2003		110,331	HI				Resurrection Bay	2,5H
2002	Crooked Creek	Ft Richardson	2004		89,388	HI				Resurrection Bay	2,5H
2003	Crooked Creek	Ft Richardson	2005		100,088	HI				Resurrection Bay	2,5H ⁸
Ninilchik River											
1991	Ninilchik River	Ft Richardson	1992	31-21-04	132,387	M-R	43,648	41,335	31.20%		
1992	Ninilchik River	Ft Richardson	1993	31-21-59	184,585	M-R	44,487	42,960	23.30%		
1993	Ninilchik River	Ft Richardson	1994	31-23-18	201,513	M-R	46,193	45,535	22.60%		
1994	Ninilchik River	Ft Richardson	1995	31-24-35	54,902	TI	54,902	54,353	99.00%		
1995	Ninilchik River	Ft Richardson	1996	31-25-15	51,688	TI	51,588	50,866	98.60%		
1996	Ninilchik River	Ft Richardson	1997	31-26-08	50,698	TI	50,698	50,292	99.20%		
1997	Ninilchik River	Ft Richardson	1998	31-26-35	48,798	TI	48,798	47,480	97.30%		
1998	Ninilchik River	Ft Richardson	1999	31-01-47	49,853	TI	49,853	48,906	98.10%		
1999	Ninilchik River	Ft Richardson	2000	31-02-48	51,298	TI	51,298	50,016	97.50%		
2000	Ninilchik River	Ft Richardson	2001	31-02-60	54,770	TI	54,770	54,441	99.40%		
2001	Ninilchik River	Ft Richardson	2002	31-02-82	54,631	TI	54,631	54,139	99.10%	Ninilchik River	2,3H
2002	Ninilchik River	Ft Richardson	2003	31-02-56, 31-01-83	47,997	TI	47,997	44,349	92.40%	Cook Inlet	2,3H
2002	Ninilchik River	Ft Richardson	2004	31-03-18	51,303	TI	51,303	51,252	99.90%	Cook Inlet	2,3H
2003	Ninilchik River	Ft Richardson	2005	31-03-41	55,229	TI	54,806	54,898	99.40%	Cook Inlet	2,3H ⁸

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				Total Released		Coded Wire Tagging			Thermal Marking		
Brood			Release			Type of	Clipped	Tagged	Percent		
Year	Broodstock	Hatchery	Year	CWT Code	Estimate	Estimate ^a	Fish Released ^b	Fish Released	Tagged	Mark Group	Hatch Code
Seldovia											
1993	Crooked Creek	Elmendorf	1994	31-23-11	107,246	M-R	46,754	45,439	42.40%		
1994	Homer ^c	Elmendorf	1995	31-24-29	116,165	M-R	41,609	40,678	35.00%		
1995	Ninilchik River	Elmendorf	1996	31-25-10	118,274	M-R	40,667	39,610	33.50%		
1996	Ninilchik River	Elmendorf	1997	31-25-57	103,757	M-R	41,279	39,834	38.39%		
1997	Ninilchik River	Elmendorf	1998	31-26-31	69,461	M-R	40,654	40,125	57.77%		
	Ninilchik River	Elmendorf	1999-01 ^h								
2001	Ninilchik River	Elmendorf	2002		83,045	VOL				Kachemak Bay	2,4H3
2002	Ninilchik River	Ft Richardson	2003		107,521	HI				Cook Inlet	2,3H
2003	Ninilchik River	Elmendorf	2004		88,682	VOL				Cook Inlet	2,3H
2003	Ninilchik River	Ft Richardson	2005		114,984	HI				Cook Inlet	2,3H ^g
Ship Creek											
1993	Ship Creek	Elmendorf	1994	31-23-12	199,830	M-R	44,138	42,864	21.50%		
1994	Ship Creek	Elmendorf	1995	31-24-28	218,487	M-R	40,764	38,570	17.70%		
1995	Ship Creek	Elmendorf	1996	31-25-08	231,444	M-R	41,221	40,109	17.30%		
1996	Ship Creek	Elmendorf	1997	31-25-56	326,371	M-R	40,522	40,319	12.36%		
1997	Ship Creek	Elmendorf	1998	31-26-30	204,741	M-R	42,073	41,565	20.30%		
1998	Ship Creek	Elmendorf	1999	31-01-42	197,168	M-R	44,265	42,262	21.44%		
	Ship Creek	Elmendorf	2000-01 ^h								
2001	Ship Creek	Elmendorf	2002		290,501	VOL				Ship Creek	2,4H4
2002	Ship Creek	Ft Richardson	2003		329,416	HI				Cook Inlet	2,3H
2002	Ship Creek	Ft Richardson	2004		209,060	HI				Cook Inlet	2,3H ^f
2003	Ship Creek	Elmendorf	2004		111,166	HI				Cook Inlet	2,3H
2003	Ship Creek	Ft Richardson	2005		344,191	HI				Cook Inlet	2,3H ^g
2004	Ship Creek	Elmendorf	2005		13,838	VOL					

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				Total Released		Coded Wire Tagging			Thermal Marking		
Brood			Release			Type of	Clipped	Tagged	Percent		
Year	Broodstock	Hatchery	Year	CWT Code	Estimate	Estimate ^a	Fish Released ^b	Fish Released	Tagged	Mark Group	Hatch Code
Valdez Area											
1998	Deception Cr	Ft Richardson	1999	31-26-22	49,353	TI	46,528	45,923	93.05%		
1999	Deception Cr	Elmendorf	2000	31-01-37	115,582	M-R	41,728	41,060	35.52%		
2000	Deception Cr	Elmendorf	2001	31-02-39	94,701	HI	44,418	43,974	46.43%		
2001	Deception Cr	Ft Richardson	2002	31-02-58	107,861	HI	43,833	42,650	39.54%	Prince William Sound	2,4H
2002	Deception Cr	Ft Richardson	2003		109,661	HI				Prince William Sound	2,4H
2002	Deception Cr	Ft Richardson	2004		99,464	HI				Prince William Sound	2,4H ^f
2003	Deception Cr	Ft Richardson	2005		143,209	HI				Prince William Sound	2,4H ^h
Whittier Area											
1998	Deception Cr	Ft Richardson	1999	31-26-24	49,797	TI	45,023	43,897	88.21%		
1999	Deception Cr	Elmendorf	2000	31-01-39	119,389	M-R	43,551	42,898	35.93%		
2000	Deception Cr	Elmendorf	2001	31-02-40	95,823	HI	42,800	42,458	44.31%		
2001	Deception Cr	Ft Richardson	2002	31-02-59	109,763	HI	45,854	44,799	40.81%	Prince William Sound	2,4H
2002	Deception Cr	Ft Richardson	2003		109,700	HI				Prince William Sound	2,4H
2002	Deception Cr	Ft Richardson	2004		107,705	HI				Prince William Sound	2,4H ^f
2003	Deception Cr	Elmendorf	2004		20,906	VOL				Prince William Sound	2,4H
2003	Deception Cr	Ft Richardson	2005		118,059	HI				Prince William Sound	2,4H ^g

^a M-R is mark-recapture; TI is tagging inventory count; HI is hatchery inventory count; VIS is a visual estimate; VOL is volumetric estimate.

^b Beginning in 2005, number of clipped fish released is adjusted to reflect percentage of acceptable fin clips observed at release.

^c Homer (Crooked Creek)

^d Corrections for release numbers reported in the 1999 report.

^e Release group missed last temperature decrease during thermal marking. Should have had hatch code of 2,4H5.

^f See 2004 Marking report for altered mark details.

^g See 2005 Marking report for altered mark details.

^h Stocking continued, but releases did not contain tagged or thermally marked fish.

ⁱ Homer (Kasilof River)